

WHAT IS CLAIMED IS:

1. A stay-in-place composite form for increasing the strength and durability of concrete support structures comprising:

5 a composite shell having an inner wall surface defining an enclosure into which a concrete may be poured and allowed to harden to form a concrete core within the enclosure, the composite shell comprising at least one fabric layer having a plurality of fibers and a resin matrix impregnated therein; and

10 a liner affixed to the inner wall surface of the composite shell to protect the composite shell from alkalinity and other chemical effects in the concrete core formed within the enclosure, the liner including at least one sheet of a water-impermeable material, wherein when concrete is poured into the enclosure and allowed to harden the liner is in direct contact with an outer surface of the concrete core.

15 2. The form of claim 1, wherein the plurality of fibers elongate as the concrete is poured into the enclosure due to a weight of the concrete, and partially shrink back to compensate for shrinkage of the concrete as the concrete dries to form the concrete core.

20 3. The form of claim 1, wherein the plurality of fibers are selected from the group consisting of glass, carbon, boron, graphite, polyaramid, boron, Kevlar, silica, quartz, ceramic, polyethylene, and aramid.

25 4. The form of claim 1, wherein the plurality of fibers have a lesser percent of elongation than the resin matrix.

5. The form of claim 4, wherein a percent of elongation of the plurality of fibers and resin matrix prevents a gap from forming between the concrete core formed in the enclosure and the composite shell, when the concrete shrinks.

30 6. The form of claim 1, wherein the liner comprises one of the group consisting of plastic, natural rubber, polystyrene, vinyl, polyethylene, chlorosulfonated polyethylene, neoprene, ethylene-propylene-diene (EPDM) terpolymer, and other water proofing membrane.

7. The form of claim 1, further comprising:

an anchor extending into the composite shell and projecting into the enclosure of the composite shell; and

5 a reinforcing bar for strengthening the stay-in-place form coupled to the anchor to affix the reinforcement bar to the composite shell.

8. The form of claim 7, wherein the reinforcing bar comprises a fiber composite.

10 9. The form of claim 7, wherein the reinforcing bar comprises steel.

10. The form of claim 1, wherein the composite shell completely surrounds the concrete core.

11. The form of claim 1, wherein the liner completely surrounds the concrete core.

12. The form of claim 1, wherein the composite shell and the liner partially surround the concrete core.

20 13. A stay-in-place support structure comprising:

a composite shell having an inner wall surface defining an enclosure, the composite shell comprising at least one fabric layer having a plurality of fibers and a resin matrix impregnated therein;

a concrete core within the enclosure of the composite shell; and

25 a liner affixed to the inner wall surface of the composite shell and in direct contact with an outer surface of the concrete core, wherein the liner includes at least one sheet of a water-impermeable material and protects the composite shell from alkalinity and other chemical products in the concrete core formed within the enclosure.

30 14. The support structure of claim 13, wherein the plurality of fibers elongate as the concrete is poured into the enclosure due to a weight of the concrete, and partially shrink back to compensate for shrinkage of the concrete as the concrete dries to form the concrete core.

15. The support structure of claim 13, wherein the plurality of fibers are selected from the group consisting of glass, carbon, boron, graphite, polyaramid, boron, Kevlar, silica, quartz, ceramic, polyethylene, and aramid.
- 5 16. The support structure of claim 13, wherein the plurality of fibers have a lesser percent of elongation than the resin matrix.
17. The support structure of claim 16, wherein a percent of elongation of the plurality of fibers and resin matrix prevents a gap from forming between the concrete core formed in the enclosure and the composite shell, when the concrete shrinks.
- 10 18. The support structure of claim 13, wherein the liner comprises one of the group consisting of plastic, natural rubber, polystyrene, vinyl, polyethylene, hypalon, neoprene, ethylene-propylene-diene (EPDM) terpolymer, and other water proofing membrane.
19. The support structure of claim 13, further comprising:
an anchor extending into the composite shell and projecting into the enclosure of the composite shell; and
a reinforcing bar coupled to the anchor to affix the reinforcement bar to the composite shell.
- 20 20. The support structure of claim 19, wherein the reinforcing bar comprises a fiber composite.
- 25 21. The support structure of claim 19, wherein the reinforcing bar comprises steel.
22. The support structure of claim 13, wherein the composite shell completely surrounds the concrete core.
- 30 23. The support structure of claim 19, wherein the liner completely surrounds the concrete core.

24. The support structure of claim 19, wherein the composite shell and the liner partially surround the concrete core.

25. A method of manufacturing a stay-in-place composite shell, the method comprising the steps of:

applying a liner to an exterior surface of a tubular member, the liner including at least one sheet of a water-impermeable material;

applying a fabric layer having a plurality of fibers to the liner;

impregnating the fabric layer with a resin matrix to form a resin-impregnated fabric layer; and

removing the tubular member once the resin matrix cures to form a composite shell having an inner wall surface defining an enclosure into which concrete may be poured and allowed to harden.

26. The method of claim 25, wherein the plurality of fibers elongate as the concrete is poured into the enclosure of the composite shell due to a weight of the concrete, and partially shrink back as the concrete dries to compensate for shrinkage of the concrete, and

wherein the liner protects the composite shell from alkalinity in the concrete.

27. The method of claim 25, wherein the step of applying a fabric layer to the liner comprises the steps of:

suspending the tubular member with the liner applied to the exterior surface of the tubular member; and

rotating the tubular member while wrapping the fabric layer around the liner.

28. The method of claim 25, wherein the step of removing the tubular member once the curable resin cures to form a composite shell having an inner wall surface defining an enclosure comprises the steps of:

cutting a slit in the tubular member;

pulling a portion of the tubular member inward at the slit to reduce the diameter of tubular member; and

pulling the tubular member away from the liner to form a composite shell having an inner wall surface defining an enclosure.

29. A method of manufacturing a stay-in-place composite shell, the method comprising the steps of:

wrapping a water-impermeable liner around a mandrel;

wrapping a fabric layer having a plurality of fibers, around an exterior surface of the water-impermeable liner;

impregnating the fabric layer with a resin matrix; and

separating the mandrel from the water-impermeable liner and fabric layer once the resin matrix cures, to form a composite shell having an inner wall surface defining an enclosure into which concrete may be poured and allowed to harden to form a concrete core,

wherein the plurality of fibers elongate as concrete is poured into the enclosure of the composite shell due to a weight of the concrete, and partially shrink back as the concrete dries to compensate for shrinkage of the concrete, and

wherein the water-impermeable liner is wrapped with its lateral edges secured together to line an inner wall surface of the composite shell and protects the composite shell from alkalinity in the concrete core.

30. The method of claim 29, further comprising the step of:

rotating the mandrel about a center axis while wrapping a fabric layer impregnated with a resin matrix and having a plurality of fibers, around an exterior surface of the water-impermeable liner.

31. A method of manufacturing a stay-in-place composite shell, the method comprising the steps of:

wrapping a water-impermeable liner around an exterior surface of a reusable form;

rotating the reusable form about an axis while applying a fabric layer impregnated with a resin matrix and having a plurality of fibers, to the exterior surface of the water-impermeable liner; and

removing the reusable form once the resin matrix cures, to form a composite shell having an inner wall surface defining an enclosure into which concrete may be poured and allowed to harden to form a concrete core,

wherein the plurality of fibers elongate as concrete is poured into the enclosure of the composite shell due to a weight of the concrete, and partially shrink back as the concrete dries to compensate for shrinkage of the concrete, and

wherein the liner is wrapped with its lateral edges secured together to line an inner wall surface of the composite shell and protect the composite shell from alkalinity in the concrete core.